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XLII.—*On the Classification of the Cyclostomacea of Eastern Asia.* By William T. Blanford, A.R.S.M., F.G.S.

The most generally received system of classification for the various forms of operculated land-shells is, I believe, that of Dr. Pfeiffer, as amended in the supplement, published in 1858, to his invaluable work, the 'Monographia Pneumonopomorum viventium.' The additions which have since been made to the genera belonging to the group in most cases fall naturally into the several divisions proposed.

My own observations have been limited to the land-shells inhabiting India and Burma; but a close comparison of a large number of these, together with the examination, in many genera, of the animals, has induced me to believe that several slight alterations and one or two important changes are requisite in Dr. Pfeiffer's classification, in order to bring it into accordance with the natural affinities of the forms included. I propose, therefore, in the present paper, briefly to review the various admitted genera and subgenera, to propose a few additions, and to add some remarks upon the distribution and mutual affinities of several of the species.

Too much stress appears to me to have been placed upon the structure of the operculum. In some instances the characters of genera, or even of subfamilies, mainly based upon this portion of the animal, only apply to a minority of the species or genera included. So long as an examination of the animal was impracticable, it was only natural that much importance should be attached to the structure of the operculum; and doubtless it is in general a valuable indication of the affinities of different species. But there are many cases in which its structure alone is insufficient to establish the relations of the animal. One remarkable instance may be quoted: *Cyclostoma semistriatum*, Sow., and *C. filocinctum*, Bens., both have a concentric, multispiral,

and duplex operculum, horny internally and testaceous externally, with a raised, shelly, lamellar edge to the whorls, the only essential distinction being in the degree of development of that lamellar edge. These two species were both classed with *Cyclotus*; yet, as I shall have occasion to show, they really belong to distinct families.

Dr. Pfeiffer's classification is the following, the Eastern genera alone being enumerated :—

Order PNEUMONOPOMA.

Suborder *Opisthophthalma*.

Family I. **Aciculidæ**. (Truncatella.)

Fam. II. **Diplommatinidæ**. (Diplommatina, ?*Paxillus*.)

Suborder *Ectophthalma*.

Family I. **Cyclostomidæ**.

Subfamily 1. Cyclotinæ. (Cyclotus, *Opisthoporus*, Pterocyclos, Alycæus.)

Subfam. 2. Cyclophorinæ. (Aulopoma, Cyclophorus, Leptopoma, *Dermatocera*.)

Subfam. 3. Pupininæ. (Megalomastoma, Cataulus, Raphaulus, Streptaulus, *Pupinella*, Pupina, *Registoma*, *Callia*.)

Subfam. 4. Licininæ. (*No Asiatic representatives*.)

Subfam. 5. Cyclostominæ. (Otopoma, Cyclostomus*.)

Subfam. 6. Cistulinæ. (*No Asiatic representatives*.)

Subfam. 7. Pomatiasinæ. (Pomatias.)

Subfam. 8. Realinæ. (Hydrocena.)

Family II. **Helicinidæ**†. (Helicina.)

Of the above genera, those in italics are not known to occur within the area to which the following remarks especially apply. This area comprises Hindustan, with the Himalayas, Ceylon, Assam, and the Burmese provinces, both British and independent.

The additional genera to which I shall refer are *Opisthostoma*, H. Blanf., *Spiraculum*, Pearson, *Rhiostoma*, Bens., *Clostophis*, Bens., *Hybocystis*, Bens., *Cyathopoma*, W. Blanf., *Jerdonia*, W. Blanf., and one or two new generic or subgeneric groups.

The principal amendments which I shall propose are in the

* *C. trochlea*, Bens., was assigned to this genus by Dr. Pfeiffer, but in error. The restricted genus *Cyclostoma* or *Cyclostomus* is really without Asiatic representatives.

† Dr. Pfeiffer's terminations for the names of families and subfamilies are rather different. I have preferred using those commonly employed in English works.

position of *Diplommatina*, of all the *Cyclotinæ*, and of the Indian forms ascribed to *Hydrocena*.

1. Truncatella, Risso.

Only a single species of this genus (*T. Ceylanica*, Pfr.) is known to inhabit Ceylon, and none have as yet been met with elsewhere in India. The species, so far as I am aware, presents no peculiarities.

2. Diplommatina, Bens.

Dr. Pfeiffer, in his monograph, placed this genus between *Alycæus* and *Megalomastoma*; in the Supplement, he makes it the type of a totally distinct family, of the suborder *Opisthophthalma*, which is characterized by the eyes being placed above the base of the tentacles. I have never seen living specimens of any of the *Aciculidæ*; but, judging from the plates in Adams's 'Gen. Rec. Moll.,' the position of the eyes is very similar to that seen in the *Auriculacea*. This is by no means the case in *Diplommatina*, in which genus the eyes, although higher in position than in other Cyclostomaceous genera, are rather at the side of the head than above it; and there is no trace of the long proboscis of *Truncatella*. The operculum also is concentric and horny; but, from the minute size of the species, and the manner in which the operculum is withdrawn far within the shell, it is, in most cases, difficult to examine it. In some species, as in *D. Nilgirica*, W. & H. Blanf., the spiral structure is obsolete.

The Indian *Diplommatinæ* may be divided into two groups, with distinct geographical distribution. The more numerous type inhabits the Eastern Himalayas and Burma, and comprises the following species:—

D. pachycheilus, Bens. Sikkim.
D. pullula, Bens. Sikkim.
D. Blanfordiana, Bens. Sikkim.
D. diplocheilus, Bens. Khasi Hills.
D. polypleuris, Bens. Khasi Hills.
D. exilis, W. Blanf. Ava.
D. Pappensis, W. Blanf. Ava.
D. sperata, W. Blanf. Pegu;

and two other species from Pegu as yet undescribed. These are all characterized by a continuous peristome (the upper portion being broadly appressed on the penultimate whorl), the presence of a columellar tooth, and by strong transverse (vertical) costulation on the whorls. The antepenultimate whorl is far broader than the rest, and the spire above it is more or less acuminate.

The two species from the peninsula of India described by my brother and myself, viz. *D. Nilgirica* from the Nilgiri Hills, and

D. Kingiana from the Kolamully Hills, are distinguished by their cylindrically-ovate form, smooth whorls, continuous circular peristome not expanded into a callus upon the penultimate whorl, by the absence of a columellar tooth, and by the regular convexity of the sides of the spire. The earliest described species, *D. folliculus*, Bens., and its congeners in the Western Himalayas, *D. costulata*, Bens., and the sinistral *D. Huttoni*, Pfr., are to some extent intermediate between the two types; but they approach less nearly, in their costulated whorls, more acuminate spire, and less circular mouth, to the Peninsular forms than to those of the Eastern Himalaya*.

I have lately found, in the Western Ghats near Bombay, a very peculiar minute species, belonging to the Peninsular type, but distinguished from every other form in the genus by possessing spiral sculpture.

3. Opisthostoma, H. Blanf.

Since the discovery of the minute *O. Nilgiricum*, described by my brother, Mr. H. F. Blanford, in the 'Journal of the Asiatic Society of Bengal' for 1860, no additional form of this most remarkable genus has been met with, nor do any more specimens appear to have been collected.

In the 'Malakozoologische Blätter' for the present year (p. 39), Dr. Dohrn, reviewing our papers, considers this form as probably belonging to the *Pupinidæ*, and remarks especially on its resemblance to the Philippine *Arinia*. This tends to confirm our belief in its Cyclostomaceous affinities, of which, indeed, there can be little doubt; but the position of *Arinia* itself is far from being satisfactorily determined, and it is classed by many writers (*e. g.* Pfeiffer and Adams) with *Diplommatina*. It appears probable that, in all the characters which tend to connect *Opisthostoma* with *Arinia*, the former shell approaches equally to certain forms of *Diplommatina*, partly to the Indian forms, and also in some respects to the sinistral group of Australia. In its costulation and minute size, *Opisthostoma* certainly approaches *Diplommatina*, and differs from the Pupinidæ, which are mostly characterized by the absence of sculpture. The last whorl in many species of *Diplommatina* rises so far in front of the shell as almost to touch the antepenultimate; so that it is easy to understand the connexion with the singular distortion of the last whorl of *Opisthostoma*, which, on the other hand, has nothing approaching to the peculiar slits and tubes characterizing the aperture of most of the Pupinidæ.

* This is by no means the only instance in which the land-shells of the Western Himalaya are more nearly allied to those of India proper than are the species inhabiting the same mountains further east.

Mr. Benson suggested to us, some years since, that the cause of our being unable to detect the operculum in the perfectly fresh specimens obtained was, that it was retracted far within the aperture as in *Diplommatina*. Taking all the characters into consideration, there appears good reason to believe that this genus must be classed as an abnormal member of the *Diplommatina* group.

4. Clostophis, Bens.

A single specimen of this genus, in which the last whorl descends freely, was obtained by Mr. Benson from Molmain. I have never had an opportunity of seeing the specimen, and know it by the description alone. Judging from that, and taking into consideration the abnormal character of the last whorl, which appears to present in its peculiarities the converse of *Opisthostoma*, there appears reason to believe that this minute form will also prove to belong to the *Diplommatina* group.

Doubtless numerous species of these very minute genera have escaped the notice of collectors; for, unless most careful and special search is made for them, they will certainly remain unobserved, more especially if large and handsome forms occur in the same locality, and attract attention.

Subfamily Cyclotinæ.

I have long had reason to doubt the correctness of uniting the genera *Cyclotus*, *Pterocyclos*, and *Alycæus* into one subfamily. The Indian forms of the first genus always appeared to me to possess a considerable resemblance to *Cyclostoma* and *Otopoma*. *Pterocyclos*, on the other hand, is very closely allied to *Cyclophorus*; while *Alycæus* has no close affinity with any other genus, but appears to possess some slight points of agreement with certain Pupininæ. The characters of the subfamily, moreover, as given by Dr. Pfeiffer, derived from the operculum alone, are only applicable to some of the genera included. These characters are:—"Operculum crassum, e duabus laminis compositum (exteriore plerumque calcarea, interiore cornea, ambabus sulco marginali separatis) orbiculare, arctispirum, nucleo centrali." Now the operculum in all the species of *Alycæus* which I have examined (twenty at least) is thin, composed of a single lamina, and without any marginal sulcation. In *Pterocyclos* there is no duplication nor marginal sulcation; and the operculum in many species (e. g. *P. Cumingi*, Pfr., *P. rupestris*, B.,) cannot be said to be orbicular. For these several reasons I believe that the genera united under this subfamily must be redistributed.

5. Cyclotus, Guilding.

To this genus five Indian species have been referred, viz. :—

C. semistriatus, Sow.
C. subdiscoideus, Sow.
C. spurcus, Grat.
C. montanus, Pfr.
C. filocinctus, Bens.

The last I shall refer to presently as the type of the genus *Cyathopoma*. With *C. spurcus* and *C. montanus* I am unacquainted. I have a large number of specimens of *C. subdiscoideus*, from Orissa, and *C. semistriatus*, from Poona, lying before me, and I am unable to observe any constant character by which they can be distinguished,—the slight expansion of the peristome occurring in specimens of both, and the spiral sculpture and height of spire being to some extent variable characters. My specimens do not suffice to prove an absolute passage, although they indicate its probability.

I have referred to the resemblance of the shells of these species to certain forms of *Cyclostoma*; but the concentric character of the operculum would have induced me to class them with *Cyclophorus*; and I was somewhat surprised, on examining the animal of *C. semistriatus*, to find that it possessed the long looping muzzle, longitudinally cleft foot, and peculiar mode of reptation of *Cyclostoma* (e. g. *C. elegans*). There can therefore be no longer any doubt that this species and its allies must be classed near *Otopoma*; and the question arises whether the whole of the forms arranged by Dr. Pfeiffer and others in the genus *Cyclotus* have similar affinities. I suspect not. The genus may be divided into several sections, which I will briefly note.

I. The American species, which have little in common with those of Asia and the Asiatic islands, but which, probably, like *C. semistriatus*, should be classed with *Cyclostoma*. They have been distinguished as *Aperostoma* and *Cyrtotoma*. I am not aware if the animals of these shells have been examined; but it is not very probable that either they or the American forms ascribed to *Cyclophorus* and *Megalomastoma* are really congeneric with the oriental species. They more probably represent them, just as the *Sesara* section of *Nanina* does the *Tridopsis* division of *Helix*, the shells in this case being so similar that they would certainly be classed together but for essential distinctions in the animal.

II. *C. filocinctus* and its allies.

III. The typical forms. The types of the genus *Cyclotus*, as established by Swainson, are stated by Pfeiffer (Mon. Pneum.

Viv. p. 16)* to be *C. variegatus*, Swains., and *C. planorbulus*, Lam., both from the Philippines. These shells possess a closely wound, thick operculum, membranaceous internally and subtestaceous without, very similar indeed to that of *Opisthoporus*, except that the latter is hollow within—a distinction the importance of which may be over-estimated. There is a deep sulcation round the margin, and considerable concavity externally. The shell is smooth or nearly so, very depressed, subdiscoidal, with a thick epidermis, and is generally precisely similar to the discoidal forms of *Cyclophorus* (e. g. *C. stenostomus*, Sow.), and especially to certain Burmese species (as *C. calyx*, Bens.), to which the *Cycloti* are doubtless very closely allied. The other Philippine species (*C. mucronatus*, Sow., *C. pusillus*, Sow., *C. scalaris*, Pfr., *C. substriatus*, Sow.) will be classed in the restricted genus, which doubtless comprises also the three Chinese species, as well as those of Cochin-China, Java, Borneo, &c., and several from the Moluccas, lately described by Dr. von Martens in the 'Malakoz. Blätter.' The nearest allies of the genus thus restricted being apparently amongst the species of *Cyclophorus*, *Cyclotus* must be referred to the same subfamily as that genus.

IV. *C. Macgillivrayi*, Pfr., from the New Hebrides, may very possibly be a depressed form of the type for which Dr. Gould has proposed the generic name *Ostodes*. The operculum is subtestaceous, but otherwise in no respect different from that of some *Cyclophori*. *C. daucinus*, Pfr., and *C. Recluzianus*, Pfr., from the Solomon Islands, may be related; but these species are only known to me by description.

V. Omitting a few dubious species, there only remain the four Indian forms, and *C. conoideus*, Pfr., from the Seychelles and Mauritius, which very probably belongs to the same type as *C. semistriatus*. These species are nearly affined to *Lithidion*, but differ in their concentric operculum, and, being well distinguished from all known genera, must be classed by themselves. I propose to call them

CYCLOTOPSIS, n. g.

Testa late umbilicata, depressa v. turbinato-depressa, spiraliter lirata; apertura subcirculari. Operculum *concentricum*, multispirum, duplex, interne membranaceum, externe testaceum, marginibus anfractuum externis elevatis.

Animal *Cyclostomatis*, haud *Cyclophori*.

Type, *C. semistriatus*, Sow.

This genus will be classed as a subgenus of *Cyclostoma* by all who consider *Otopoma* and *Lithidion* as such. It may, as above suggested, be related to *Aperostoma*. In the raised margins of

* I have not access to the original work at present.

the whorls of the operculum there is some resemblance to the West-Indian *Choanopoma*; but the shells are very different. It forms an additional link between the Indian fauna and that of Africa and South-western Asia*.

6. Jerdonia, W. Blanf.

Testa umbilicata, pyramidata, cornea. Operc. concentricum, arctispirum, sulco marginali circumdatum, duplex; interne membranaceum, externe testaceum, et ex anfractibus vittæformibus compositum, quoque proximi interioris marginem externum tegente.

Type, *J. trochlea*, Bens., sp.

Although I proposed this genus two years ago (Journ. Asiat. Soc. Bengal for 1861, vol. xxx. p. 351), I have never published the characters in full. The species upon which it is founded is a peculiar minute, pyramidal, horny, tricarinated shell inhabiting the Nilgiri Hills, and which, in the absence of the operculum, was referred by Dr. Pfeiffer (Mon. Pneum. Viv. Supplement, p. 116) to *Cyclostoma*. The operculum I obtained in 1859, and it proved to have the peculiar structure described above†. It bears no inconsiderable resemblance to that of *Cyclotus variegatus*, Sw., differing mainly in the inner edge of each whorl resting upon the outer edge of the next, whereas in *Cyclotus*, and in general throughout the *Cyclophoridæ*, the reverse is seen.

The position of this peculiar shell is still somewhat obscure; but as the operculum is, despite its singular structure, more nearly allied to that of *Cyclotus* than to any other, it may, in default of a knowledge of the animal, be classed with the *Cyclophorinæ*, and may possibly be related to the next genus.

In the paper above referred to as published in the 'Journ. Asiat. Soc. of Bengal,' I was disposed to refer a second species, from the Kolamully Hills of South India to this genus. Further examination of this form, the operculum and animal of

* Throughout the fauna of the Indian peninsula there is a blending of Africano-Asiatic and of Malayan forms. In the Mammalia, amongst the Carnivora are found species of the African Lion and Hyæna, and the Caucasian Wolf, Fox, and Jackal, with the Malayan Tiger, Paradoxure, &c.; and in the Ruminantia, the African types in the Indian forms of Antelope, with the Malayan Rusa- and Axis-deer and *Bos gaurus*. Amongst the birds the same is seen,—species of the Malayan Jungle-fowl and Peacock co-existing with those of the African Sand-grouse and *Francolin*. In the land-shells, Malayan types of *Nanina*, *Cyclophorus*, &c., accompany African forms of *Bulimus*, *Otopoma*, &c. As might be expected, the African representatives predominate in the west of the peninsula, Malayan in the east; and the former frequently occur on the plains, the latter on the hills, the fauna of which often resembles the Malayan types of the Himalayas.

† It is figured in the illustrations to the paper in the 'Journ. As. Soc. Bengal' above referred to.

which are unknown, induces me to class it with *Cyathopoma*. It is probable, however, that, as in other cases, representative forms of *Jerdonia* may hereafter be found on the other hill-groups of the Indian peninsula or of Ceylon.

7. Cyathopoma, W. Blanf.

Testa umbilicata, turbinata v. turbinato-depressa, epidermide crassa, sæpe hispidula induta, plerumque spiraliter lirata. Operculum truncate conoideum, concentricum, multispirum, e duabus laminis compositum; interna membranacea, externa testacea perconcava; anfractuum marginibus externis in lamellam testaceam, versus medium incurvatam, interdum pulchre sculptam, elevatis.

Animal *Cyclophori*.

Type, *C. filocinctum*, Bens., sp.

The forms comprised in this genus of minute shells (the largest known is only 3 millimetres in diameter) are all peculiar to the hills of the Indian peninsula. Two, belonging to distinct sections, have been found on the Nilgiris, one on the Kalryenmully Hills, near Salem, and a fourth on the Western Ghats, near Bombay. A somewhat similar form has lately been found in the Andaman Islands by Mr. Theobald, who has kindly sent me a specimen. It differs, however, in several minor characters of the shell, and in wanting the very peculiar operculum of *Cyathopoma*, and appears more nearly allied to a section of *Cyclophorus* peculiar, so far as is known, to Burma.

The animal of *Cyathopoma* is white, with a short oval foot, undivided beneath, and has small black tentacles, with eyes at the base.

The known species are the following:—

1. Spirally lirate.

C. filocinctum, Bens.
C. Kalryenense, H. Blanf.
C. ——, n. sp. (undescribed). Western Ghats near Bombay.

2. Smooth.

C. Malabaricum, W. Blanf. Nilgiri Hills.
C. Kolamulliense, W. Blanf. Kolamully Hills.

8. Pterocyclos, Bens.

This is one of the best-marked types of the Cyclophoroid group, so far as regards its Indian (and typical) representatives; but, in Burma, it passes almost imperceptibly into forms of *Cyclophorus*. I have alluded in a previous paper (Ann. & Mag. Nat. Hist. for July 1863) to the relations of the incision in the inner and cowl-shaped process of the outer lip of the peristome

to the tubes in other genera of the *Cyclophoridæ*. There can be no doubt that the "wing" in *Pterocyclos* is a rudimentary tube, although no portion of the animal has been observed to correspond with it.

The species of this genus may well be distinguished into two sections.

1st. Those inhabiting the Indian peninsula and Ceylon, viz.:—

P. rupestris, Bens. Bengal, Behar, Orissa.
P. bilabiatus, Bens. Hills of South India (base).
P. nanus, Bens. Nilgiri Hills.
*P. Cumingi**, Pfr. Ceylon.

These are all characterized by their very convex opercula.

2nd. The Burmese forms—

P. parvus, Pearson. Assam and Arakan†.
P. pullatus, Bens. Pegu.
P. ——, n. sp. Thayet Myo, Pegu.

Also, probably, *P. cetra*, Bens., from Molmain, and *P. Albersi*, Pfr., from the Khasi Hills. In these the operculum is nearly flat, while the wing of the peristome is much less developed than in the forms of the Indian peninsula. No species have as yet been obtained from the Himalaya. It is worthy of note that the Indian species with the least-convex operculum and smallest wing is the Nilgiri *P. nanus*, Bens., thus affording an-

* I am doubtful whether *P. Cingalensis*, Bens., be more than a variety of *P. Cumingi*, Pfr. The duplication of the peristome is frequently a character depending upon the age of the shell, which, of course, may vary in specimens collected at different periods of the year. Moreover, which of the Cingalese species is *P. Troscheli*, Bens.? Probably *P. Cumingi* or *P. bifrons*, Pfr., which may possibly be only varieties of one species. *P. Troscheli* was described from a drawing, at a time when the fauna of Ceylon was almost completely unknown. This has changed, and the land-Mollusca of Ceylon are now far better known, and have been much more largely collected than those of many parts of India; and it is very improbable that the species has been overlooked. Descriptions of species from drawings, unless those drawings have been made by persons intimately acquainted with the critical distinctions of allied species, are never satisfactory; and when, as in this case, three or four other species have been subsequently described from the same geographical area, differing from that first named and from each other in minute characters which would infallibly be overlooked by an ordinary observer, it is very improbable that all are really distinct. It is to be hoped that some of the numerous collectors of Ceylon shells may possess specimens of a *Pterocyclos* from Trincomalee, which would go far towards deciding the question.

† Specimens of a *Pterocyclos* which I found in Arakan, at Akyab, and of which a flatter variety occurred further south, near Tongoop, agree generally with the description of *P. parvus*. The operculum is plano-concave within (the central boss being very slightly prominent) and nearly flat without, with free lamellar edges to the whorls.

other instance of the affinity of the hill-fauna of Southern India to Malayan types.

9. Spiraculum, Pearson; and 10. Opisthoporus, Bens.

The genus *Spiraculum*, distinguished by the possession of a retroverted sutural tube open at both ends, and by a modification of the form of the mantle corresponding to the same, has, I think, better claims to generic distinction from *Pterocyclos* than even *Rhiostoma*. Its claim to separation from *Pterocyclos* I believe equal to that of *Opisthoporus* from *Cyclotus*; and I should be inclined to class *Opisthoporus* as a subgenus of *Spiraculum*, as I have little doubt that the animal of the former genus, when examined, will be found to be similar in structure to that of the latter.

Mr. Benson has lately described, under the name of *Opisthoporus Gordoni*, a species from Molmain, in Burma, which may, I think, very possibly prove to be a *Spiraculum*, when the operculum is obtained, as the known geographical range of forms belonging to that genus approaches far nearer to Molmain than that of *Opisthoporus*. To whatever type it may belong, it serves admirably to illustrate the extremely close affinity between them, since there is no character possessed by it which may not be found in one or the other form of each genus. *S. Avanum*, W. Blanf., has a duplicate lip and a smooth surface; while an undescribed species occurring in Assam has the last whorl free for a longer distance than in any known species of *Opisthoporus*; and it has also a more prominent projection from the upper portion of the peristome. The sole difference between the two genera is in the structure of the operculum.

11. Rhiostoma, Bens.

The projection from the upper portion of the peristome in this species differs from that in *Spiraculum* and *Opisthoporus* in being accompanied by a deep incision in the inner peristome, clearly showing that it is the homologue of both wing and incision in *Pterocyclos*, and of both projection and sutural tube in the first-mentioned genera. In *R. Housei*, Pfr., the projection indeed forms a perfect tube. *Rhiostoma* is doubtless a good type, although species may very probably be met with connecting it with *Pterocyclos* more closely than is now the case. A single species (*R. Haughtoni*, Bens.) is found at Molmain; all others are Malayan.

12. Aulopoma, Troschel.

I have no especial remark to offer upon this genus, which has not hitherto been met with out of Ceylon.

13. Cyclophorus, Montfort.

Within the area to which these observations especially apply there exist several distinct series of forms of this well-known and important genus, some of them differing from the type at least as widely as *Leptopoma* does. These should be separated as subgenera.

I. Of the several groups classed under *Cyclophorus*, one of the most distinct is that for which the following appellation was, a few years ago, suggested by Mr. Theobald. It may be thus characterized:—

Lagocheilus, Theobald, MS.

Testa anguste umbilicata, turbinato-conica, parva, spiraliter lirata, epidermide fusca (in exemplis junioribus sæpe hispidula) induta. Peristoma incrassatum, superne ad angulam rima transversa breviter incisum. Operculum planum, tenue, albidum.

Type, *C. scissimargo*, Bens., from Tenasserim.

The other species (all from Burma) are

C. tomotrema, Bens. Khasi Hills.

C. ——, n. sp. Pegu.

The animal of the last species has a longitudinal groove above the posterior end of the foot, somewhat as in the Auriculoid genus *Melampus*.

The shells are all about the same size as *C. halophilus*, Bens., and its allies, but easily distinguished by their thickened lip, greater solidity, and the peculiar slit at the angle of the upper margin of the peristome. To this section the little species found by Mr. Theobald in the Andamans, and previously referred to, appears to belong.

II. The next group* comprises certain discoidal shells, also Burmese, as a type of which *C. calyx*, Bens., may be selected. The operculum is thicker than in other *Cyclophori*, and has free and rough margins to its whorls, so as to be absolutely identical with that of *Pterocyclos pullatus* and it allies. In *C. calyx*, also, there is a slight expansion of the outer peristome at the suture corresponding to the wing in *Pterocyclos*. A similar slight expansion is seen in *C. phænotopicus*, Bens., from the Himalayas, which, however, has a thin operculum. I consider, therefore, that in these forms and in the Burmese species of *Pterocyclos* we have that almost complete passage from one genus into the other, to which I have already referred, and clear evidence of their close natural affinity. There can be little doubt that *Pterocyclos* belongs to the same subfamily as *Cyclophorus*;

* For this section I proposed, in a paper printed in the 'Journal of the Asiatic Society of Bengal' for 1863 (p. 322), the name *Scabrina*. Further study of the genus has led me to the conclusions expressed above.

and its associated genera, *Rhiostoma*, *Spiraculum*, &c., must fall into the same group.

This little section, the species of which also agree in their velvety epidermis, when in good condition, appears to coincide in so many points with the subgenus *Myxostoma* of Troschel, that it may probably be classed with that section. The characters of the Burmese species are

Testa late umbilicata, depressa, subdiscoidea, epidermide fusca hispidula induta; anfractibus rotundatis. Apertura circularis, peristomate incrassato. Operculum crassum, corneum, anfractuum marginibus lamellatim elevatis.

The species included are—

C. pinnulifer, Bens. Khasi Hills.
C. calyx, Bens. Molmain*.
C. hispidulus, W. Blanf. Ava.

III. The discoidal species of India and Ceylon, with thin opercula. These are—

C. phænotopicus, Bens. Darjiling.
C. ravidus, Bens. Nilgiri Hills and Ceylon.
C. stenostomus, Sow. Nilgiri Hills.
C. deplanatus, Pfr. Nilgiri Hills.
C. annulatus, Trosch. Ceylon.
C. Bairdii, Pfr. Ceylon;

and one or two Ceylonese species with which I am unacquainted. *C. Bairdii*, *C. stenostomus*, and *C. deplanatus* are so closely allied as to be scarcely more than local varieties; and the same is the case with *C. ravidus* and *C. annulatus*.

IV. A group of shells arranged by Pfeiffer under *Leptopoma*, but differing from the species of that genus in the non-expanded peristome, in the rounder whorls, more globose forms, slower increase in the size of the whorls, and consequent comparative smallness of the mouth, and in the tendency to a rapid and irregular descent of the last whorl in aged specimens. The species are peculiar to Ceylon and Southern India, and comprise the following:—

C. cœloconus, Bens. Southern India.
C. malleatus, W. Blanf. Shevroy and Nilgiri Hills.
C. halophilus, Bens. Ceylon.
C. orophilus, Bens. Ceylon;

and three or four other Ceylonese species, the differences between which and the two last mentioned are very minute.

* The locality is, I believe, erroneously given as Akoutoung, Pegu. I have collected largely and repeatedly at that locality, but never met with a specimen; whereas the shell is abundant at Molmain.

V. But a solitary species is known, of another type, as yet only found upon the Nilgiri Hills—*C. cuspidatus*, Bens. I have been enabled to examine the operculum of a specimen belonging to the Madras Museum, through the kindness of Capt. Mitchell. It differs widely from that of any *Cyclophorus*, being far more closely wound. The thick dark epidermis, forming a fringe round the carination of the last whorl, the peculiar acuminate form, and the concave sides of the spire form a combination of characters which entitle this species to at least subgeneric distinction. It may be called

Craspedotropis, nov. subg.

Testa acuminato-conoidea, carinata, epidermide fusca crassa fimbriam carinæ præbente induta. Operculum arctissime spiratum.

It is very probable that, as in the case of *Cyathopoma*, other species may be found to inhabit the other hill-groups of the peninsula or of Ceylon. Should they show no passage into *Cyclophorus*, this may fairly be ranged as a distinct genus.

VI. The typical species, e. g. *C. involvulus*, Müll., *C. Indicus*, Desh., *C. Aurora*, Bens., *C. fulguratus*, Pfr., *C. aurantiacus*, Schum., &c. These species are in many cases so variable, and at the same time are distinguished from each other by such very minute and unimportant characters, that a revision of the whole group is most desirable. I regret very much that I have not the materials at hand for the work. A very large weeding-out of dubious species and of varieties is required; but, in order that this may be effectual, access to a greater number of the types of described species than I can examine at present is requisite.

14. Leptopoma, Pfr.

Omitting the Ceylonese and South-Indian group already mentioned, which certainly belongs to *Cyclophorus*, and passes through *C. cœloconus* into the depressed section of that genus comprising *C. stenostomus* and its allies (No. III. of the preceding classification), there are no *Leptopomata* described from the Indian peninsula*; but two are attributed to Ceylon, and three to Burma. The two Ceylonese species (*L. semiclausum*, Pfr., and *L. apicatum*, Bens.) I have never seen; they may be a modified form of the group of *Cyclophorus halophilus*, Bens., with thickened peristomes. They do not appear to be true *Leptopomata*. The Burmese species are

L. Cybeus, Bens. Khasi Hills.
L. Burmanum, Pfr. Tenasserim.
L. aspirans, Bens. Tenasserim.

* *L. vitreum*, Sow., is quoted from the Nilgiris; but it is very improbable that it has really been found at that locality.

Of these, *L. Cybeus* I consider a *Cyclophorus*, probably only adolescent; and my impression, derived from a comparison of the type-specimens in Mr. Theobald's cabinet, and of some fine and fresh examples of *C. zebrinus*, Bens., from the same locality, was that the former were merely a variety, perhaps immature, of the latter. I would, however, wish to repeat the observation before expressing a definite opinion, and merely suggest the idea as probable.

L. Burmanum, Pfr., I have not seen; but it also appears, from the description, to be very probably an immature *Cyclophorus*, many young shells of that genus having very thin and membranaceous opercula. In this, as in so many other cases, the characters of the operculum alone are insufficient for generic distinction.

The sole remaining species, *L. aspirans*, Bens., is a true *Leptopoma*, with the peculiar form, peristome, and texture of shell characteristic of the genus. It has a wide range, being found in the Tenasserim provinces, near Basscin in Pegu, and throughout Arakan as far north as Akyab.

It is only by confining the name *Leptopoma* to the peculiar and well-marked type, species of which are so numerous in the Indian Archipelago and the Philippine Islands, that it can be considered to have claims even to subgeneric distinction. At the best it appears to have no better claim to be separated from *Cyclophorus* than has *Myxostoma* or *Lagocheilus*; and its proper position is probably as a subgenus.

15. Alycæus, Gray.

This genus was founded on a solitary species from Cochin China, and only three forms were enumerated in Dr. Pfeiffer's monograph published in 1852. In 1858 the number had increased to fourteen, almost all the additional species being from the Indian area. I now possess no less than thirty-five species, being all the described Indian forms with the exception of *A. Andamaniæ*, Bens., and all others, so far as I am aware, except *A. gibbus*, Fér., and *A. pilula*, Gould.

The known forms from the Indian and Burmese area amount to thirty-one, of which one has not yet been described. No type in the whole order is better characterized nor more distinct from all others, no approach to a passage into any other genus being yet known. I have already referred to the broad distinction between *Alycæus* and *Cyclotus*; the former is equally distinct from *Cyclophorus*, despite the similarity of the operculum. But the singular and anomalous form of the shell induces me to believe that it can best be classed in a subfamily by itself; and this view is borne out by the peculiar texture of the shell,

by its sculpture, which is distinct in general from that of any other of the *Cyclostomacea*, except *Diplommatina*, and in the absence of any tendency to coloured zigzag markings—a character which may not appear of much value at first, but which is nevertheless singularly constant throughout the genera *Cyclophorus*, *Pterocyclos*, *Opisthoporus*, *Cyclotus*, &c.—in fact, nearly all the *Cyclophorinæ*. The animal is similar to that of *Pupina*, having short, black tentacles, and differs in no essential point from *Cyclophorus*.

The large addition to the number of species renders it possible to define more exactly the generic characters; and the following may be suggested:—

Testa perforata v. umbilicata, conica, turbinata, globosa vel depressa, unicolor, albido- v. succineo-cornea, rarius rubella. Anfractus convexi, ultimus ad latus tumidus (spatio inflato sculptura confertiore plerumque ornato), deinde prope aperturam constrictus, tubulo suturali externo, pone stricturam oriente, antice in anfractu aperto, cum spatio inflato longitudine concordante, postice clauso munitus. Peristoma circulare, plerumque incrassatum vel reflexum. Operculum corneum (rare subtestaceum?), multispirum, nucleo centrali interno prominente sæpe munitum.

In the 'Ann. & Mag. Nat. Hist.' for March 1859, Mr. Benson suggested the division of the genus into a typical section and two subgenera, which he named *Charax* and *Dioryx*, distinguishing the three sections by the characters of the constriction, the typical group embracing such species as have "the last whorl constricted somewhat remotely behind the aperture, tumid on both sides of the constriction." In the section *Charax*, the constriction is "broad, contiguous to the aperture, and divided more or less remotely from it, across the whorl, by a ridge, which is hollow internally." In *Dioryx* the constriction is "narrow and immediately behind the aperture."

This distinction appeared at the time to be good, with the exception that one of the species referred to *Dioryx* (*A. crenulatus*, Bens.) was more closely allied in most of its characters to a form of *Charax* than to the members of its own section. But there was evidently, after the removal of this species, a much closer alliance between *Charax* and the typical group than between either of those types and *Dioryx*. To this Mr. Benson referred in his paper, and also to the fact that the Western Himalayan species, *A. strangulatus*, Hutt., showed a tendency to a passage from *Charax* to the typical section. Since the publication of Mr. Benson's observations, some other species have been discovered, especially *A. Theobaldi*, W. Blanf., and *A. polygonoma*, W. Blanf., which are also intermediate in the characters of the constriction; and it may be doubted whether the form of

this one portion of the shell is sufficient for a division of the genus.

The section *Dioryx*, however, as proposed (provided the depressly turbinate and strongly sculptured species *A. crenulatus* be omitted) consists of a very natural and well-marked group of forms, all of a somewhat globose shape, with a short sudden constriction close to the peristome, and smooth (or, at the most, striated), while nearly all other species are more or less strongly costulated, at the inflated portion of the last whorl. There may perhaps be some slight affinity between these peculiar globose forms and the tubulated genera of the *Pupininæ*, especially *Raphaulus*.

The subgenus *Dioryx*, as thus defined and restricted, embraces the following species:—

A. amphora, Bens. Molmain, Burma.
A. urnula, Bens. Darjiling, Sikkim.
A. distortus, Haines. Siam and Cambodia, Himalayas.
?*A. pilula*, Gould. Hong-Kong, China;

and a fifth species from Cambodia, obtained by M. Mouhot, of which I have not learned the name.

It will be observed that this group prevails to the eastward, only one solitary representative being found on the Himalayas. Doubtless other species, in considerable numbers, of all sections of the genus *Alycæus* may yet be found in the unexplored Malay and Chinese countries and in some of the large islands of the archipelago*.

The description of *A. pilula* is very imperfect, and I have never seen the species; but it may possibly belong to *Dioryx*, as no transverse sculpture is mentioned as occurring on the whorls. The spiral striation is peculiar.

The remaining species of *Alycæus* are, for the most part, very difficult to distinguish by any one special character, though they may easily be grouped round different typical species. In this way we may obtain seven more or less well-marked sections, which may be briefly described.

I. Type, *A. gibbus*, Fér. Shell perforated, subpyramidal; constriction remote from the aperture; sculpture fine; sutural tube elongated.

A. gibbus, Fér. Cochin China.
A. pyramidalis, Bens. Tenasserim, Burma.

* The great proportion of large shells to small amongst the species described from the Philippine Islands, and the different ratio found elsewhere, where the minute forms have been carefully sought for, renders it probable that the Molluscan land-fauna even of those islands has only as

II. Type, *A. constrictus*, Bens. Shell perforated, ovately conical; sculpture consisting of very few ribs on the inflated portion of the shell; sutural tube very short.

A. constrictus, Bens. Darjiling.
A. bembex, Bens. Darjiling.
A. otiphorus, Bens. Darjiling.
A. graphicus, W. Blanf. Arakan Hills, Burma.

III. Type, *A. polygonoma*, W. Blanf. Shell subturbinate, narrowly umbilicated, with the peristome more or less crenulated; sculpture fine.

A. polygonoma, W. Blanf. Arakan Hills, Pegu.
A. succineus, W. Blanf. Arakan Hills, Pegu.
A. Vulcani, W. Blanf. Puppa Hill, in the kingdom of Ava.

IV. Type, *A. crenulatus*, Bens. Shell turbinately depressed, solid, costulated.

a. Peristome fimbriated.
A. crenulatus, Bens. Darjiling.
A. plectocheilus, Bens. Darjiling.
b. Aberrant; peristome not fimbriated.
A. vestitus, W. Blanf. Arakan Hills.

V. Type, *A. sculptilis*, Bens. Shell perforated, subtrochiform, costulated, compressed at the periphery.

A. sculptilis, Bens. Pegu.
A. Rechthofeni, W. Blanf. Molmain.
A. Jagori, Von Martens. Java?

VI. Type, *A. umbonalis*, Bens. Shell depressed, solid, strongly costulated; constriction remote, simple.

A. umbonalis, Bens. Pegu.
A. Ingrami, W. Blanf. Arakan.
A. Andamaniæ, Bens. Andaman Islands.
A. physis, Bens. Darjiling.
A. prosectus, Bens. Khasi Hills.
A. armillatus, Bens. Thayet Myo, Pegu.
A. humilis, W. Blanf. Akoutoung, Pegu.
A. ——, n. sp. Arakan.

VII. Type, *A. strangulatus*, Hutt. Shell depressed or depressly turbinate, costulated; constriction broad, crossed by a ridge or swelling. (*Charax*, Bens.)

a. Ridge crossing the constriction not recurved; shell depressed.
A. strangulatus, Hutt. Western Himalayas.

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yet been very partially explored. It is remarkable that Dr. von Martens should not have met with either this genus or *Diplommatina* in the Moluccas.

A. expatriatus, W. Blanf. Nilgiri and Shevroy Hills, South India.
A. Footei, W. Blanf. Kolamully Hills, South India.
A. Theobaldi, W. Blanf. Khasi Hills.
A. Avæ, W. Blanf. Ava.
A. stylifer, Bens. Darjiling.
A. spiracillum, A. Adams & Reeve. Borneo and Japan!

b. Ridge recurved; shell depressed, turbinate.

A. hebes, Bens. Khasi Hills.
A. gemmula, Bens. Darjiling.
A. nitidus, W. Blanf. Arakan.

It will be noticed that many of these sections are restricted in their geographical distribution.

16. Raphaulus, Pfr.

In a previous paper (Ann. & Mag. Nat. Hist. for July 1863, vol. xii. p. 55) I have described the peculiar structure of the animal in *R. chrysallis*, Pfr., the only Burmese species of this genus. The other two known species are from Penang and Borneo. The shell is remarkable as forming a link between the various genera of *Pupininæ*. It possesses the general form of *Pupina* and *Registoma*, and the tube is the homologue of the incisions in the peristome of those species; at the same time, it resembles *Hybocystis* in the ventral flattening of the last whorl, and *Megalomastoma* and *Cataulus* in its sculpture.

17. Streptaulus, Bens.

This genus appears to represent, in the Himalayas of Sikkim, the *Raphauli* and *Pupinæ* of Burma, Malacca, and Borneo. It was described by Mr. Benson (Ann. & Mag. Nat. Hist. for 1857, vol. xix. p. 201) as intermediate between *Raphaulus* and *Alycæus*, on account of the characters of the sutural tube. In this view of its affinities I cannot coincide. The tube in *Streptaulus*, as in *Raphaulus*, opens inside the body-whorl, at the suture, a few millimetres within the peristome. Thence it runs internally, also as in *Raphaulus*, forwards to the aperture; and in the normal variety it passes out through the top of the lip, and runs backwards for a short distance along the suture, being open at the extremity; the external portion is somewhat irregular, thin, and liable to decay. The course is precisely similar to that in *R. chrysallis*, except that the tube, after emerging from the body-whorl, runs backwards instead of upwards. It is quite distinct from the course in *Alycæus*, in which the tube is never internal, and is, moreover, closed externally. But this is not all: in two species of *Raphaulus* (*R. bombycinus*, Pfr., and *R. Lorraini*, Pfr.)

the tube opens externally in the peristome itself. Now, there is a small variety of *Streptaulus Blanfordi* (which perhaps has claims to specific distinction) in which precisely the same takes place, the tube not running backwards along the suture, but opening in the peristome. In no character of the shell can *Streptaulus* be considered to agree with *Alycæus*; nor, I think, can a generic separation from *Raphaulus* be founded upon the very slight variation in the sutural tube, in the course of which there is quite as great a diversity between *R. chrysallis* and *R. bombycinus* as between either of these and *Streptaulus*; and if the distinction be preserved, it must be founded upon another character. Such a character is presented by the form of *Streptaulus*, which, in place of being flattened ventrally, and having the upper whorls distorted as in *Raphaulus*, has all regular as in *Pupina*. But I doubt if this character alone be of more than subgeneric value, and I should therefore conclude that the present type is a subgenus of *Raphaulus*, and that it tends to connect that genus, not with *Alycæus*, but with *Pupina*.

I regret that I have not noted the animal of *Streptaulus*. It is probably similar to that of *Raphaulus*. Should the soft tube leading to the air-chamber prove to be wanting, there will be better grounds for generic distinction.

18. Pupina, Vign.

Only four species of this form are known from Burma and the neighbouring countries, viz.:—

P. imbricifera, Bens. Khasi Hills.
P. artata, Bens. Molmain.
P. arula, Bens. Molmain.
P. Peguensis, Bens. Eastern Pegu.

P. artata also occurs in Arakan and throughout the Irrawaddy valley as far north as Ava. It is a somewhat variable shell—one variety, from the neighbourhood of Prome and Thayet Myo, being somewhat more globose than the type, and having a rich orange peristome.

No member of this genus has yet been found upon the Himalayas, where *Streptaulus* alone represents the group, the members of which diminish greatly in number towards the north.

The animal possesses no peculiarities. It is almost colourless, with short tentacles and distinct black eyes at the base, a moderate oval foot with the sole undivided, and short proboscis. It differs from *Cyclophorus* and its allies only in the shorter and less subulate tentacles and rounder foot.

19. Hybocystis, Bens.

The animal of *H. gravida*, Bens., is similar to that of *Pupina*;

the general form of the shell resembles *Raphaulus*. There is no trace of a sutural tube, or of any modification of it. The operculum is very peculiar, and unlike that of any other genus amongst the Cyclophoridæ*.

A second species of this genus, very closely allied to *H. gravida*, was obtained from the Laos Mountains, Cambodia, by M. Mouhot. I am indebted to Mr. Hugh Cuming for specimens both of this species and of the *Alycæi* from the same locality.

20. Megalomastoma, Guilding.

Three species from India and Burma have been assigned to this genus, viz. :—

M. funiculatum, Bens. Darjiling.
M. pauperculum, Sow. Bhotan.
M. sectilabre, Gould. Tenasserim.

A fourth very closely allied species is found in Borneo.

I have very little doubt that *M. pauperculum* is merely a variety of *M. funiculatum*. The latter species is common at Darjiling, at 6000 to 7000 feet elevation. Above this elevation a variety occurs in which the basal keel is less pronounced, the shell somewhat thicker, and the colour of the epidermis olivaceous; and this I believe to be the form to which the name of *pauperculum* was given. There is a complete passage between the two varieties, the smaller of which formerly abounded on the top of Sinchul, a mountain near Darjiling, between 8000 and 9000 feet high.

M. funiculatum is peculiarly interesting, as showing in a rudimentary form the basal keel which is typical of the Ceylonese genus *Cataulus*.

Dr. Gould has suggested for the Asiatic species of *Megalomastoma* the generic appellation of *Coptocheilus*, stating that, with the exception of *M. Antillarum*, all the West-Indian species differ greatly in form from the East Indian. This is true; but the exception vitiates the distinction. I have very little doubt indeed that Dr. Gould's surmise of the distinctness of the two types will prove to be correct, and that the oriental and occidental species must be separated from each other; but I do not think that they have as yet been satisfactorily shown to have generic distinctions. The animals of the Eastern forms are allied to *Pupina* and *Cyclophorus*, having subulate contractile tentacles of moderate length, with the eyes at the side of their bases, a moderate proboscis, and a rather long undivided foot. The lingual ribbon has not been examined. It is desirable to ascer-

* I have not been able to compare the lingual ribbons of these various forms, although I obtained several of them.

tain whether the animals of the West-Indian species differ in any particular.

21. Cataulus, Pfr.

The rather numerous known species of this genus are, with two exceptions, confined to the island of Ceylon, these exceptions being one species, of abnormal form, from the Nicobar Islands, and a second, recently discovered in the Anamully Hills of South India, and specimens of which are amongst Mr. Hugh Cuming's rich collection.

I have already mentioned that the nearest approach to this genus is in a Himalayan species of *Megalomastoma**. The species of these two genera agree so well amongst themselves in form, and differ so much from the other *Pupininæ*, that they may fairly claim to be formed into a distinct subfamily, differing from the typical *Pupininæ* not only in shape, but in their thick epidermis and sculpture, and, in general, their solidity and opa-

* This alliance of the Ceylonese hill-fauna to that of the Himalayas, with its marked Malayan affinities (the connexion being, in most cases, through the hill-fauna of Southern India) is a much more rational explanation of any similarity which may exist between the animals inhabiting Ceylon and Sumatra than Sir Emerson Tennent's very startling suggestion of a former continuity of land between the two islands (Nat. Hist. Ceylon, pp. 60–67), an hypothesis in favour of which there is no geological evidence whatever. It would require too much space to enter into the matter at full length; and Dr. Falconer has amply refuted Sir Emerson Tennent's strongest argument (Nat. Hist. Review, vol. iii. p. 95). It is notorious that the fauna of the plains of Ceylon, by far the greater portion of the island, is identical with that of the plains of Southern India; the sole distinctions are founded on the species of animals inhabiting the isolated mass of hills in Southern Ceylon. But, the elephant-fallacy having been disposed of by Dr. Falconer, a comparison of lists of the known animals inhabiting Ceylon, Sumatra, and the hills of Southern India respectively would soon settle the question.

The fact is that the similarity of the Ceylon and South-Indian fauna is very marked, but that while Ceylon has enjoyed the advantage of a considerable European population scattered widely over its surface, and the presence of an unusual number of naturalists, there are few accessible parts of the world the natural history of which has been more neglected than the hills of Southern India. With the exception of the Nilgiris, scarcely anything is known concerning them. The Anamullies, exceeding the Nilgiris in height, and nearer to Ceylon, have only at rare intervals been visited, and then chiefly by sportsmen; and of the ranges further south the very names are unknown to naturalists. So ignorant have we been of their Molluscan fauna that the largest land-shell in India, *Helix basileus*, Bens., was undiscovered until six years ago, although it abounds at the foot of the Anamullies. Later still, species of *Tanalia* and *Cataulus*, genera hitherto supposed to be peculiar to Ceylon, have been obtained from the same neighbourhood. *Helix basileus* also belongs to a Ceylonese (and perhaps Malay?) type not previously met with in the Indian peninsula; and there can be no rational doubt that, with the further exploration of the South-Indian hills, the claims of those of Ceylon to be considered a distinct zoological province will vanish completely.

city,—all which contrast strongly with the polished unbroken surface and delicate translucent shells of the *Pupina* group. But, as above mentioned, the genus *Raphaulus* shows, in some of these characters, a tendency to a passage.

22. Pomatias, Studer.

Two species of Indian shells have been described by Mr. Benson, and attributed to this South-European genus, viz.:—

P. Himalayæ, Bens., from near Darjiling.

P. (*Bulimus*) *pleurophorus*, Bens. Khasi Hills.

A third species has recently been obtained by Mr. Theobald from Arakan.

These species agree well in general form and in sculpture with the European members of the genus. Some slight differences, however, in the characters of the peristome and of the operculum may be sufficient to entitle the Indian forms to sectional or even subgeneric distinction.

23. Hydrocena, Parreyss.

Several minute forms from the Khasi Hills and Burma have been described by Mr. Benson as belonging to this genus. They, however, prove, on examination of the animal and operculum, to differ so widely from the type, that I propose to distinguish them as a new genus, probably belonging to a distinct family.

Georissa, nov. gen.

Testa imperforata v. vix perforata, minima, conica, succinea v. rubella, plerumque spiraliter sulcata v. striata.

Operc. semiovale, sine ullo vestigio structuræ spiralis, excentrice striatum, testaceum, transparens.

Animal parvum, lobis hemisphæricis in loco tentaculorum munitum. Oculi normales. Pes brevis, rotundatus.

Type, *G. pyxis*, Bens., sp.

The species of which I have examined the animal is the little *G. pyxis*, Bens., from the neighbourhood of Thayet Myo in Pegu, where it abounds, adhering to limestone rocks. It is found, in similar localities, throughout the region of Pegu west of the Irrawaddy. All the other species, so far as I am aware, also occur in the neighbourhood of limestone; *G. frustillum*, Bens., from the vicinity of Ava, certainly does so. The operculum of the last-mentioned species I have also examined, and found it to be precisely similar to that of *G. pyxis*.

The other species which may be referred to this genus are

G. illex *, Bens. Tenasserim.

* The operculum of *Hydrocena illex* is described as paucispiral. In these very minute shells it is so difficult to examine the opercula, that very

G. Rawesiana, Bens. Molmain.
G. sarrita, Bens. Khasi Hills.

And perhaps

Hydrocena milium, Bens. Khasi Hills.
H. tersa, Bens. Khasi Hills.

As regards the position to be assigned to this genus amongst the operculated land-shells, it will be observed that it differs widely, in the important character of the form of the tentacles, from all other genera belonging to the Cyclostomacea; while its operculum agrees with that of the *Helicinidæ* in the absence of spiral structure and of form. It must evidently be separated widely from *Hydrocena* and *Omphalotropis,* which have the normal tentacles of the *Cyclophoridæ* and a paucispiral operculum. For the present it may perhaps be best classed as a subfamily of the *Helicinidæ* equivalent perhaps to *Stoastoma* and its allies.

24. Otopoma, Gray.

A solitary species of this genus is found in Western India, in Kattiawar, in a climate which shows a slight approximation to that of Persia and North-east Africa, being on the verge of the area of the periodical rains of India and South-east Asia. This species has been assigned to *O. clausum,* Sow., of Socotra and Arabia; but a comparison of specimens from Kattiawar with the original types of that shell in Mr. Cuming's collection has convinced me that they are distinct. The Indian form is much smoother, with a less excavated umbilical region, and a higher spire; and I propose to distinguish it as *O. Hinduorum.*

I had long supposed that this species was the only representative of the *Cyclostomidæ* known to occur in India. *O. blennus,* Bens., from Molmain, has been since shown by its describer, Mr. Benson, to have been founded in error; and *O. spurcum,* Grat., is doubtless a species of *Cyclotopsis.* The discovery of the true character of *Cyclotopsis semistriata,* Sow., proves that representatives of the family are found throughout India, but only in the peninsula, and none are known to occur in Burma.

25. Helicina, Lamarck.

A species of this genus is found as far north as Ramri Island, on the coast of Arakan. It is very closely allied to *H. Andamanica,* Bens., from the Andamans, and more remotely to the Tenasserim *H. Merguiensis,* Pfr., and is the most westerly representative of the genus yet met with in Asia.

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possibly the excentric striation has been taken for paucispiral structure. I have not been able to examine *H. illex* lately.

The following is a summary of the classification which I believe to be in accordance with the natural affinities of the various forms mentioned, and the reasons for the adoption of which I have given in the preceding pages. Believing that the several characters of the generative organs, of various parts of the mouth, of the tentacles, the universal presence of an operculum, and the form of the mantle, taken together, far outweigh those of the membranous sac which constitutes the breathing-organ, I agree with those naturalists who class the order Cyclostomacea with the Prosobranchiate Gasteropods, and not with the Pulmonifera. I also believe that the characters of the animal serve quite as fully to distinguish *Cyclophorus* and its allies from *Cyclostoma* as those of the operculum do to separate either from *Helicina*; and that if *Helicina* be considered the type of a distinct family, *Cyclostoma* must take an equal rank.

I have preserved the style of classification employed by Dr. Pfeiffer. My own prepossessions would be in favour of reducing the rank of the several divisions, and of ranging the subfamilies, with a few additions, as genera, and the genera as subgenera; but the question is rather one of convenience than of importance.

List of the Genera of Operculated Land-Shells inhabiting India and Burma.

I. CYCLOSTOMIDÆ.
- Cyclotopsis.
- Otopoma.

II. CYCLOPHORIDÆ.

1. Cyclophorinæ.
   - Cyclophorus.
     - *Leptopoma.*
     - *Lagocheilus.*
     - *Craspedotropis.*
   - Aulopoma.
   - Pterocyclos.
   - Rhiostoma.
   - Spiraculum.
     - *Opisthoporus.*
   - Cyclotus.
   - Cyathopoma.
   - Jerdonia.

2. Alycæinæ.
   - Alycæus.
     - *Dioryx.*

3. Pupininæ.
   - Raphaulus.
     - *Streptaulus.*
   - Pupina.
   - Hybocystis.

4. Megalomastominæ.
   - Megalomastoma (Coptocheilus, *Gould*).
   - Cataulus.

5. Pomatiasinæ.
   - Pomatias.

6. Diplommatininæ.
   - Diplommatina.
   - Opisthostoma.
   - Clostophis.

III. HELICINIDÆ.

1. Helicininæ.
   - Helicina.

2. Georissinæ.
   - Georissa.

IV. ACICULIDÆ.
- Truncatella.